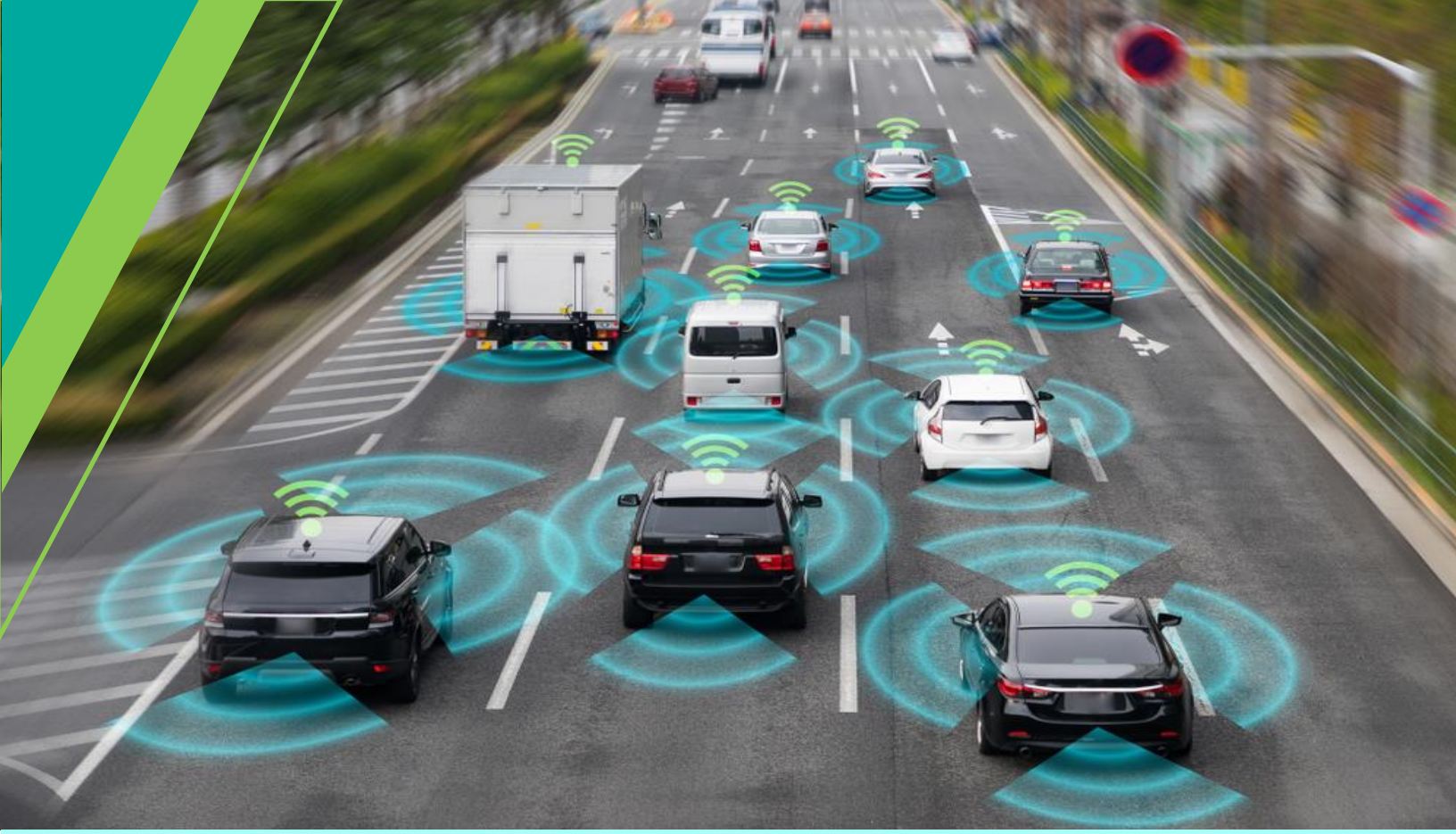

LUCINTEL INSIGHT
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SIX TRENDS SHAPING THE FUTURE OF THE MILLIMETER WAVE RADAR IC MARKET

Millimeter wave (mmWave) is a valuable sensing technology for the detection of objects and the range, velocity, and angle of these objects. Millimeter wave (mmWave) is a radar technology that uses short wavelength electromagnetic waves. MM Wave radar transmits

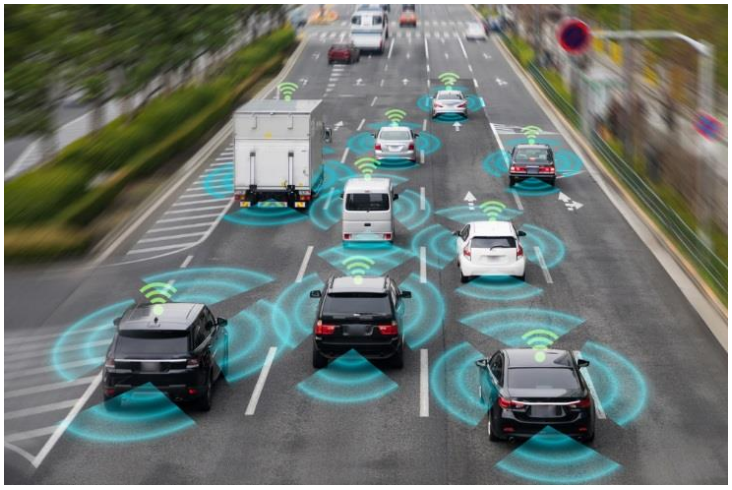
signals with a wavelength that is in the millimeter range, considered as short wavelength in the electromagnetic spectrum, and this is one of the advantages of this technology. It can provide sub-mm range accuracy and is able to penetrate certain materials such as plastic, clothing, and drywall, and is impervious to environmental conditions. Single-chip millimeter-wave radar IC, built in standard CMOS, offers a range of distance-measurement based sensing functions in automotive radar, industrial, and infrastructure applications.

The millimeter wave radar IC market is divided into the segments of GaAs, RF CMOS, and SiGe BiCMOS. Key players in the millimeter wave radar IC market, on the product development side, include Infineon Technologies AG, NXP Semiconductors N.V., Texas Instruments, United Monolithic Semiconductors, and Mitsubishi Electric Corporation. These have been working on different strategies to drive sales using the most influential marketing techniques. However, as we examine the challenges and opportunities ahead in this market, companies can benefit from a strategy of developing capabilities in RF CMOS technology and focusing on the higher frequency of 77 GHz mmWave radar IC along with their heterogeneous integration to drive toward the key target market trends we have identified. Lucintel predicts that the global millimeter wave radar IC market will be valued at $1.2 billion by 2025, with an expected CAGR of 16% to 18% between 2020 and 2025.

Lucintel identifies six trends set to influence the global millimeter wave radar IC market. Most of the industry players and experts agree that these six trends will accelerate developments in the millimeter wave radar IC industry in the near future. In terms of the widespread knowledge about the millimeter wave radar IC already on the horizon, there is still a lack of unified perspective on the direction the industry is moving to proactively address developments. To help bring more clarity to this gap, our study aims to provide insights concerning the direction that changes are taking and how these changes will impact the millimeter wave radar IC market.

1. Introduction of CMOS RF Transceivers

RF CMOS technology is entering the market with various semiconductor companies. For instance, Texas Instruments has announced it with an intermediate technology node of 45nm. CMOS technology offers the advantages of high-level integration and lower cost than III-V compounds. It aids the production of multifunction RF transceivers and RF system-on-chip designs. Here, higher levels of RF performance lead to advanced safety and autonomous driving applications. It supports a host of applications, including the high-end, long-range use required for autonomous driving and ADAS, short- to mid-range automatic emergency braking, adaptive cruise control, blind spot detection, cross traffic alerts, and ultra-short-range autonomous parking. It enables several high-level signal processing integration options and allows for custom IP integration enabling designers to differentiate their systems.



Digital scaling in CMOS decreases power and size and increases performance at every node. RF CMOS IC has been driven by these digital transistor improvements, and the speed of CMOS continues to increase and is sufficient for 79GHz ADAS applications. The 79GHz band offers the 4GHz bandwidth crucial for higher-range resolution. Thus, RF CMOS ICs provide digital assistance to the analog for adaptation, flexibility, and robustness over environmental and manufacturing variations. CMOS technology changes the design of mmWave ICs, embedding increased intelligence and capabilities. For instance, the technology has enabled Texas Instruments to deliver a high-performance, low-power mmWave radar IC portfolio, scaling from a high-performance radar front end to single-chip

radar.

2. Growing Usage in Satellite Communication

Today's global technology continues to move higher in frequency to solve various issues and improve performance. The millimeter wave (mmWave) frequencies that offer hope in solving the toughest requirements in many industries, such as satellite communication, where mmWave ICs are deployed nowadays. In telecommunication links, where the need for higher data rates continues to exceed existing techniques, solutions are moving to 28 GHz and 39 GHz. Satellite communication systems form an integral part of nations' national security. With the application of mmWave technology in satellite communication, security systems have become more efficient and reliable, modernizing respective defense systems. Additionally, many of the ICs designed for satellite communications are suitable for high-volume manufacturing to make them easier to deploy. MMIC device technologies are largely used in quasi-automated production engineering and design for production methodologies. Given the importance of secure global communications for defense applications, higher data-rate satellite systems have been deployed and are under development. Some of these rely on frequency uplinks at around 44 GHz millimeter-wave remote sensing, particularly satellite-borne remote sensing of the Earth's atmosphere at millimeter wavelengths, which provides valuable information through global mapping from space.

3. Increasing Adoption of Advanced Driver-Assistance Systems (ADAS) by OEMs in Automotive Applications

Radar ICs are widely adopted by automobile manufacturers for their high resolution at 24 GHz and 77 GHz and dependability under many different driving conditions, including fog, rain, and snow. For automotive radar systems, increased integration involves the transformation of a handful of electronic devices down to one, with analog, RF, and digital circuitry included on a single packaged integrated circuit (IC) to perform various functions, such as sensing, processing, signal generation/conversion, and others. This information provided by radar ICs is used in ADAS systems responsible for multiple applications, including autonomous emergency braking, adaptive cruise control, and others. Automotive mmWave radar ICs usually incorporate multiple transmitters and receivers to measure the range, angle, and velocity of objects in their field of view. Different types of radar ICs, even different operating frequencies, have been used in ADAS systems. The requirement for the reduction of power consumption and size in automotive applications favors the use of integrated circuits (ICs), which are used to provide different radar system function blocks, such as RF/IF circuits, digital signal processing (DSP), and microprocessors. Demand for increased ADAS functionality in smaller-sized, lower-power solutions is driving the development of automotive radar systems, which contain large numbers of ICs. Instead of using different ICs for USRR, SRR, MRR, and LRR ADAS functions, mmWave radar ICs are capable of multimode operation, which can simplify part counts and costs of newer ADAS electronic systems. It goes without saying that mmWave radar ICs play a key role in the ADAS system.

4. Increasing Usage of Millimeter Wave Radar IC in 5G

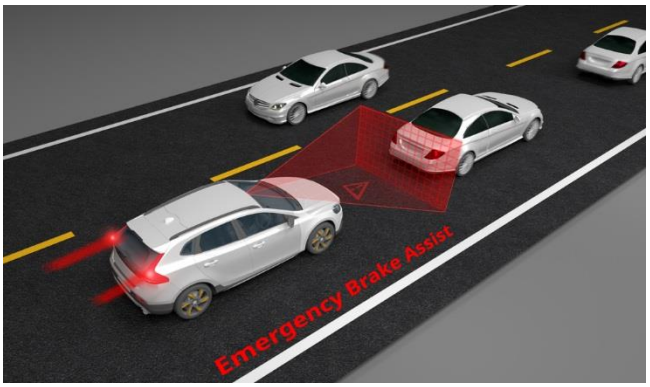
One of the major factors that affect cellular system performance is signal bandwidth, which can be added through the use of extra spectrum, thereby leading to a linear increase in the capacity of data. According to the International Telecommunication Union (ITU), millimeter wave operates in extremely high frequency (EHF) within the range of 30–300GHz. The large available bandwidth at millimeter wave (mmWave) frequencies makes MM wave ICs suitable for use in fifth generation cellular networks. Although mm-wave backhaul seems to offer a promising solution, increasing demands for 5G communication bring new challenges, which must be overcome in order to make mm-wave IC backhaul applicable to various scenarios. Traditional techniques were focused on direct single-user link, but supporting multi-streams for multi-user scenarios of mmWave radar ICs is likely to be a trend for 5G backhaul with growing traffic demands. MMWave radar ICs for 5G offer dual polarized architecture, improved RF performance, 3GPP compliance, and building blocks for a complete mmWave phased array antenna front end. They enable a scalable antenna architecture to address multiple-use cases encompassing 5G macro base stations, small cells, access points, CPE, and others.

Millimeter wave radar IC is used in 5G to serve more people, and even things, with a major expansion of mobile services. With hundreds of megahertz of wireless transmission bandwidth available at center frequencies, such as 24, 28, and 38 GHz, 5G wireless networks will be capable of almost zero-latency phone calls and extremely high data speeds. 5G innovators, such as Qualcomm of the Third Generation Partnership Program (3GPP), have been working on 5G network solutions, usually of the mmWave frequency range as starting at

about 24 GHz. The 5G portfolio supports a range from macro-cells to small-cells to customer premise equipment (CPE) in the mmWave frequencies that are now in play, and the existing 28 and 39 GHz bands where mmWave radar ICs are highly deployed.

5. Increasing Governmental Regulations for Vehicle Safety

Safety and security are major concerns for public safety and transportation. In developed regions, passive car safety systems, seat belts, airbags, and crumple zones are essential in decreasing fatalities and serious injuries to the occupants of cars and pedestrians. Government legislations drive improved automotive safety standards; the adoption of active and predictive crash avoidance safety systems has become dominant in modern vehicles. The governments of various regions and countries are taking initiatives and mandates with regard to various safety systems in their transportation systems to overcome problems related to accidents, and therewith enhance safety.



For instance, in 2015, the European New Car Assessment Program (Euro NCAP), in collaboration with the Australasian New Car Assessment Program (ANCAP), released a study on the impact of Low-Speed Autonomous Emergency Braking (AEB) on rear-end collisions. The data collected from Australia and five European countries were used for this study. The study discovered that the implementation of Low-Speed AEB technology would reduce real-world rear-end vehicle crashes by 38%. According to the ETSI standard (EN 302 264), the usage of automotive radar operating in the 77-81GHz frequency range has been legalized, and there are no restrictions on its use in the automotive domain. The National Highway Traffic Safety Administration (NHTSA) has released new federal guidelines for automated driving systems in the United States which have made these a key technology for

automobile manufacturers. The Emirate of Abu Dhabi intends to ensure the safety of road users and motorists and is constantly working to develop laws and regulations to maintain road safety, as well as reduce the rate of road accidents. It also works on improving road safety by using the latest techniques to regulate and monitor traffic flow, such as smart radar, mobile radar, and police patrols.

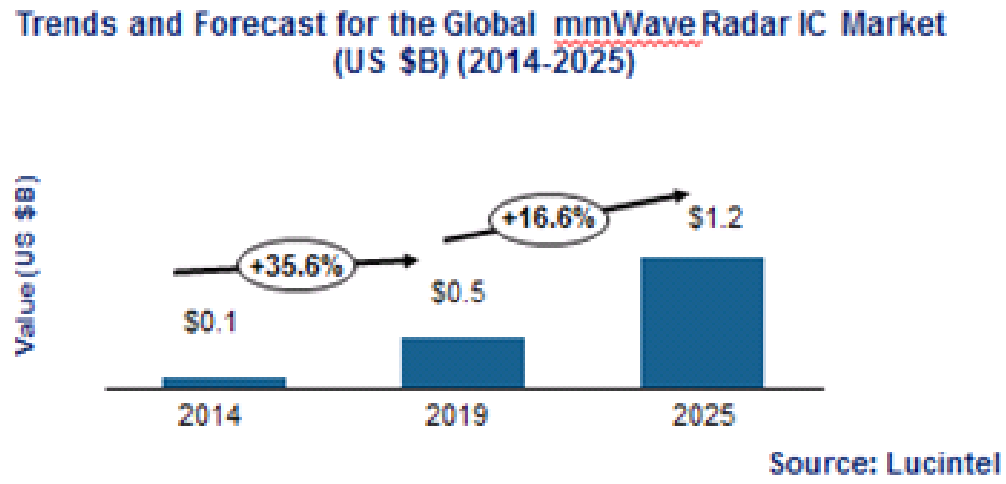
6. Focus on Miniaturization of Products

Various companies are consistently focusing on the miniaturization of millimeter-wave ICs. The major key to this successful development includes CMOS technology and single-chip IC, accomplished with a transceiver and analog-digital converters (ADC), and phase-lock loops (PLL) and digital components. The single-chip radar IC comes in a variety of bands and includes 24, 60, 76-77, and 94 GHz bands. A single-chip radar IC is used for automotive safety and convenience, such as adaptive cruise control, collision mitigation with automatic braking, lane-departure sensing, and even backup object detection. It opens a new era for radar-type measurements. A single-chip radar IC is essential for the success of a driverless car. The benefits of all RF components on a single chip are absolutely necessary at millimeter wave frequencies. The benefits include performance reliability, cost saving, smaller size, and excellent transmit-to-receive isolation.

Strategic Considerations for Key Players in the Millimeter Wave Radar IC Market

The millimeter wave radar IC industry is dynamic and ever-changing. Successful industry

players masters of innovation, change and adaptation. To retain this status, they need to be attentive to current trends. We believe there will be promising opportunities for millimeter wave radar ICs in the automotive, telecommunication, security and imaging, and healthcare industries. As per Lucintel's latest market research report (Source: https://www.lucintel.com/millimeter-wave-radar-ic-market.aspx), the millimeter wave radar IC market is expected to grow with a CAGR of 16% to 18% between 2020 to 2025, and reach $1.2 billion by 2025. This market is primarily driven by the increase in adoption of advanced driver assistance system (ADAS) technology by OEMs and increasing usage of millimeter wave in small-cell backhaul networks.



Whether you are new to the millimeter wave radar IC market or an experienced player, it is important to understand the trends that impact the development process, as these trends as listed above will lead players to create long-term strategy formulation that will allow them to remain competitive and successful in the long run. For example, to capture growth momentum, millimeter wave radar IC market players can develop capabilities in RF CMOS technology, as it has the advantage of high-level integration and lower cost than III-V compounds. Players can also focus on the higher frequency of 77 GHz mmWave radar IC in the automotive industry, which is expected to lead future trends.

Note: In order to gain better understanding, and learn more about the scope, benefits, and

companies researched, as well as other details of the millimeter wave radar IC market report from Lucintel, click on https://www.lucintel.com/millimeter-wave-radar-ic-market.aspx. This comprehensive report provides you in-depth analysis on market trends and forecast, segment analysis, regional analysis, competitive benchmarking and company profiling of key players. In addition, we also offer **strategic growth consulting** to meet your customized needs. We have worked with many PE firms and corporate customers in the process of their market entry and M & A initiatives.

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- **Management comprised of PhDs, MBAs, and subject matter experts. Head quarter in Dallas, USA.**

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